

Name	Prof. Hitoshi Iba	Place	Hongo	Research Topic	Evolutionary Computation
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Evolutionary Systems and Artificial Life

In our laboratory, research is focused on the theory and application of so-called Evolutionary Methods.

"How can such beauty exist in a peacock's feather?"

"Why does a giraffe possess such a long neck?"

"Why do worker bees tirelessly serve the queen bee, in spite of not being able to reproduce themselves?"

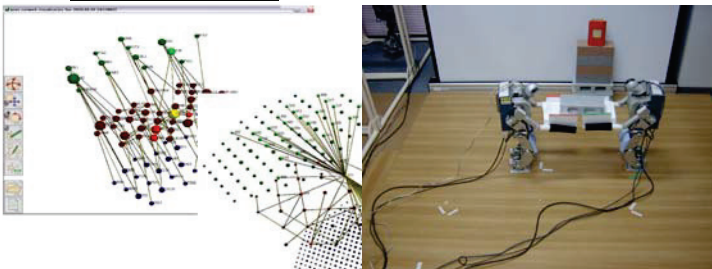
In studying the mysteries of life such as those mentioned above, we gain an understanding of how the evolutionary process is used by nature to solve certain kinds of optimization problems.

The **evolutionary method**, conceptually derived from natural evolution, is the process of transformation, aggregation and selection of data structures. It finds its purpose in solving problems of optimization which results in the generation of useful structures. By this method, we aim to solve a large array of problems, such as optimization, artificial intelligence, induction, automatic synthesis of programs and others, in what we call "**Learning from Nature**".

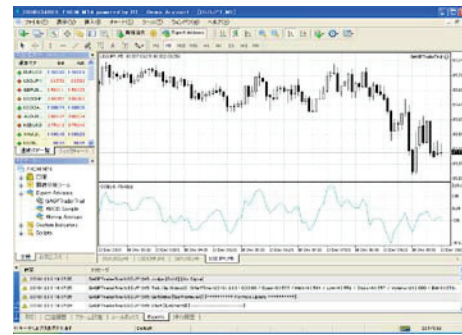
For example, consider an optimization problem, like designing an airplane. In the design of an improved flying machine, while the contribution of creative and gifted designers is certainly important, the creation of novel ideas is not necessarily the most important part of the process. More important is adapting previous airplane designs by making minor selections and modifications and then, applying these adaptations to the current design process. By this principle, the first airplanes were built in the beginning of the 20th century. The example described above illustrates the application of principles of genetic mutation, crossover and selection. In other words, by applying these principles of evolution to a design process, an optimized design can be reached.

Inference of a Gene Regulatory Network and

Visualization System



Evolutionary Robot: Cooperative Transportation by Humanoid Robots



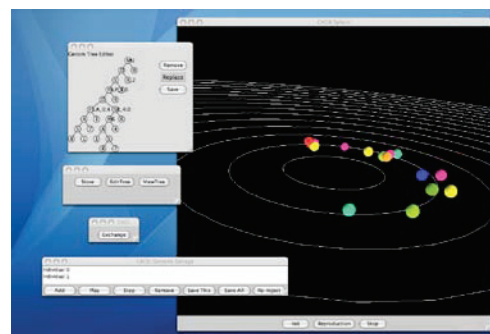
GA/GP trader for FX

The goal of the evolutionary method is to create a computational framework or system based on the above concept. Well known examples of this are "**Genetic Algorithms**" and "**Genetic Programming**". These methods have been extensively applied not only to engineering optimization tasks, but also to many other areas, such as **bioinformatics**, **synthetic biology**, **financial engineering**, **arts and design**. Another remarkable area is "**Artificial Life**", which aims at the realization of biological evolution or morphogenesis by computer simulation.

Evolutionary system research is expected to lead to the integration of engineering and life sciences, establishing the key concepts of biological phenomena, e.g., **sybiosis** or **diversity**, on a computer. Because of this, our activities are not necessarily limited to information engineering or computer science. We actively go into other research areas, such as molecular biology, economics, evolutionary biology, ecology, and population genetics. As a result of this, we often collaborate with these researchers to achieve fruitful results. We believe that this new style of research builds a new approach to engineering and computer science.

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